

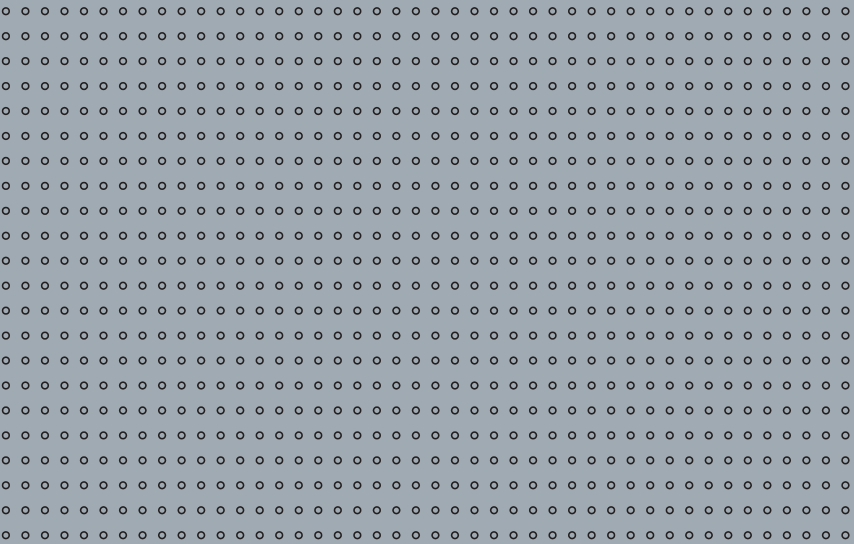


Master the Elements

# Manual

## Simrad RI9 Rudder Angle Indicator

English



### **Note!**

*Simrad makes every effort to ensure that the information contained within this document is correct. However, our equipment is continuously being improved and updated, so we cannot assume liability for any errors which may occur.*

### **Warning!**

*The equipment to which this manual applies must only be used for the purpose for which it was designed. Improper use or maintenance may cause damage to the equipment or injury to personnel. The user must be familiar with the contents of the appropriate manuals before attempting to operate or work on the equipment.*

*Simrad disclaims any responsibility for damage or injury caused by improper installation, use or maintenance of the equipment.*

### **Copyright**

© 2004 Simrad

*The information contained within this document remains the sole property of Simrad.*

*No part of this document may be copied or reproduced in any form or by any means, and the information contained within is not to be communicated to a third party, without the prior written consent of Simrad.*

# Instruction Manual

This manual is intended as a reference guide for operating and correctly installing the RI9 Rudder Angle Indicator.

Please take time to read the manual to get a thorough understanding of the indicator system and its relationship to a complete autopilot system.

Other documentation materials that are provided with your system include a warranty card. This must be filled out by the authorized dealer that performed the installation and mailed in to activate the warranty.

## Document revisions

Rev	Date	Written by	Checked by	Approved by
–	09.09.97	N.G.	I.K.	Th.H.
A	24.09.97	N.G.		Th.H.
B	21.10.97	N.G.		Th.H.
C	29.11.00	N.G.	TJ	Th.H.
D	30.06.04	N.G.		T.J.
E	03.10.06	N.G.		IK

## Document history

Rev. –	First edition
Rev. A	Approved revision of Fig. 1-8 and 1-9 included.
Rev. B	Operating temperature, page 3, corrected.
Rev. C	Connection diagram for Panorama Mk2 included. RF45X included.
Rev. D	Part number for RI9 PCB Ass'y corrected, page 10. New transmission rod for RF45X. Connection to AP50 system.
Rev. E	S1 removed on Fig. 3.4. Fig. 1-10 and 1-11 updated.

## Contents

<b>1</b>	<b>RI9 RUDDER ANGLE INDICATOR.....</b>	<b>3</b>
1.1	General .....	3
1.2	Technical specifications.....	3
1.3	Installation.....	4
	Stand alone rudder angle indicator(s) .....	5
	Connection to autopilot junction units.....	6
	RI9 set-up .....	9
1.4	Maintenance .....	12
1.5	Spare parts.....	12
<b>2</b>	<b>RF14XU RUDDER FEEDBACK UNIT.....</b>	<b>13</b>
2.1	General .....	13
2.2	Technical specifications.....	14
2.3	Installation.....	15
2.4	Wiring .....	15
2.5	Other rudder angles.....	23
2.6	Adjustments .....	24
2.7	Spare parts.....	24
<b>3</b>	<b>RF45X RUDDER FEEDBACK UNIT.....</b>	<b>25</b>
3.1	General .....	25
3.2	Technical specifications.....	25
3.3	Mounting.....	26
3.4	Electrical connection.....	28
3.5	Spare parts.....	29

# 1 RI9 RUDDER ANGLE INDICATOR

## 1.1 General

The RI9 is manufactured in non-corrosive aluminum with a non-reflective black finish.

It is designed to operate from both voltage and current signals. The RI9 can also operate from the earlier Robertson "Standard" rudder feedback units.

The indicator is made in standard modular size (144x144 mm) to match the standard of the Simrad autopilots.

A separate PCB is mounted inside the indicator to convert the input signals for the indicator instrument. To select either voltage or current operation, a "jumper" is plugged in the respective position. For voltage operation a jumper is available for inverting the feedback signal.

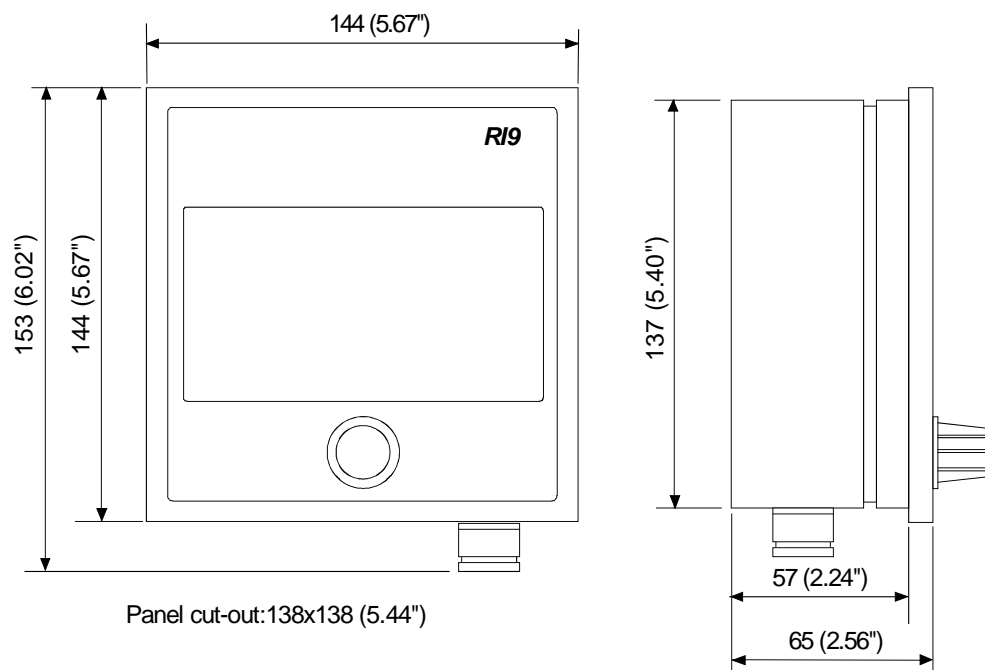
The instrument gives a continuous reading of the rudder angle up to 45 degrees on either side of the midship's position. (Other angles as optional). Both deflection and offset are adjustable on the PCB. Internal illumination can be adjusted by the dimmer control on the front.

The water tight construction allows bulkhead or desk mounting in exposed locations, such as bridge wings as well as wheelhouse and engine room.

RI9 substitutes the Robertson RI40 and RI45 rudder angle indicators.

## 1.2 Technical specifications

Dimensions: .....	See Fig. 1-1
Voltage supply: .....	12/24V DC +/-20%
Current consumption: .....	100mA
Input signal:.....	Voltage (0-18V) or current (0.1 - 1.1mA)
Reverse meter deflection: .....	On voltage input signal
Operating temperature: .....	-10°C to +55°C
Protection: .....	IP56
Safe distance to magnetic compass: ..	2.6m (9 ft)
Rudder Feedback Units: .....	RF14XU, RF14XI, RF45/RF45X, RF100, RF140, "Mini" and "Standard" Rudder Potentiometer.

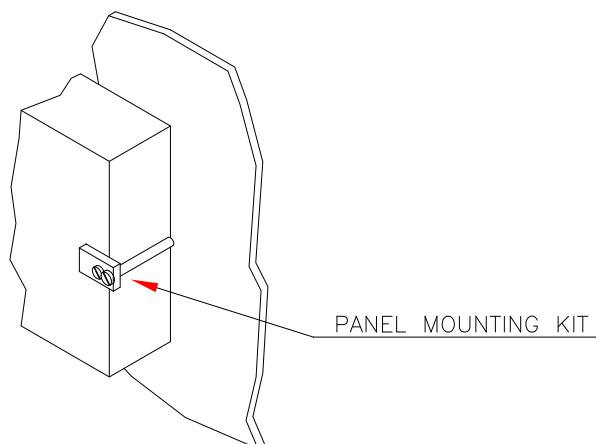


*Fig. 1-1 RI9 Dimensions*

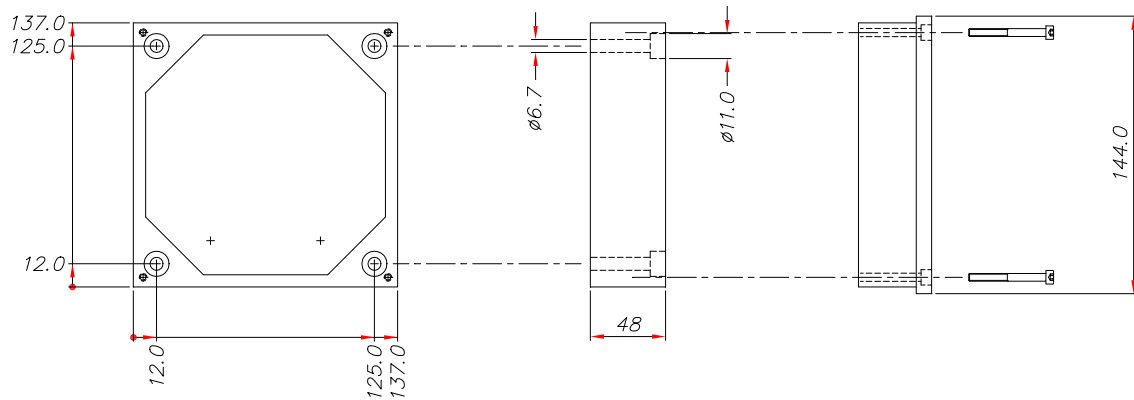
## 1.3 Installation

The RI9 is designed for bulkhead or panel mounting, and should be positioned in a location in clear view of the helmsman and the ship's officers. For bulkhead mounting, use the 8 bushings enclosed with the unit. These are placed two and two against each other and the screws are put through them. Direct contact between RI9 and a steel bulkhead is then avoided and corrosion is prevented.

Several indicators may be connected to one rudder feedback unit, in parallel for voltage input signal, and in series for current input signal.



*Fig. 1-2 RI9 Panel mounting*



*Fig. 1-3 RI9 Bulkhead mounting*

### **Stand alone rudder angle indicator(s)**

The RI9 indicator can be used in stand alone rudder angle indicator systems as described in sections 2 and 3 of this manual or as part of an autopilot system as described below.

## Connection to autopilot junction units

All interconnection cables should be screened, 1.5 mm<sup>2</sup> (AWG14) wires. See Fig. 1-4 to Fig. 1-9 for connections to the different autopilot junction units.

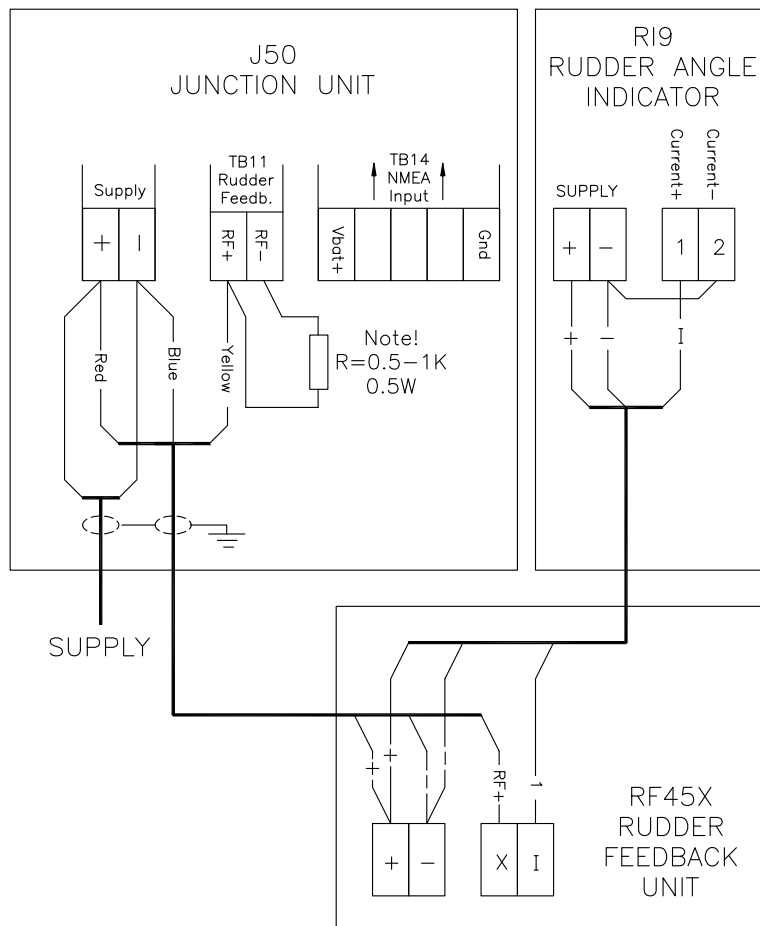


Fig. 1-4 RI9 in an AP50 system with RF45X

The above connection diagram shows how to connect an RI9 Rudder Angle Indicator to an AP50 system with RF45X Rudder Feedback Unit.

This connection gives full functioning indicator(s) also with the autopilot switched off. To have the indicator(s) switched off with the autopilot, connect indicator(s) and rudder feedback supply+ to J50 Vbat+ instead of J50 Supply+.

**Note !**

*The resistor R (0.5-1K, 0.5W) has to be mounted. The resistor is not supplied by Simrad.*



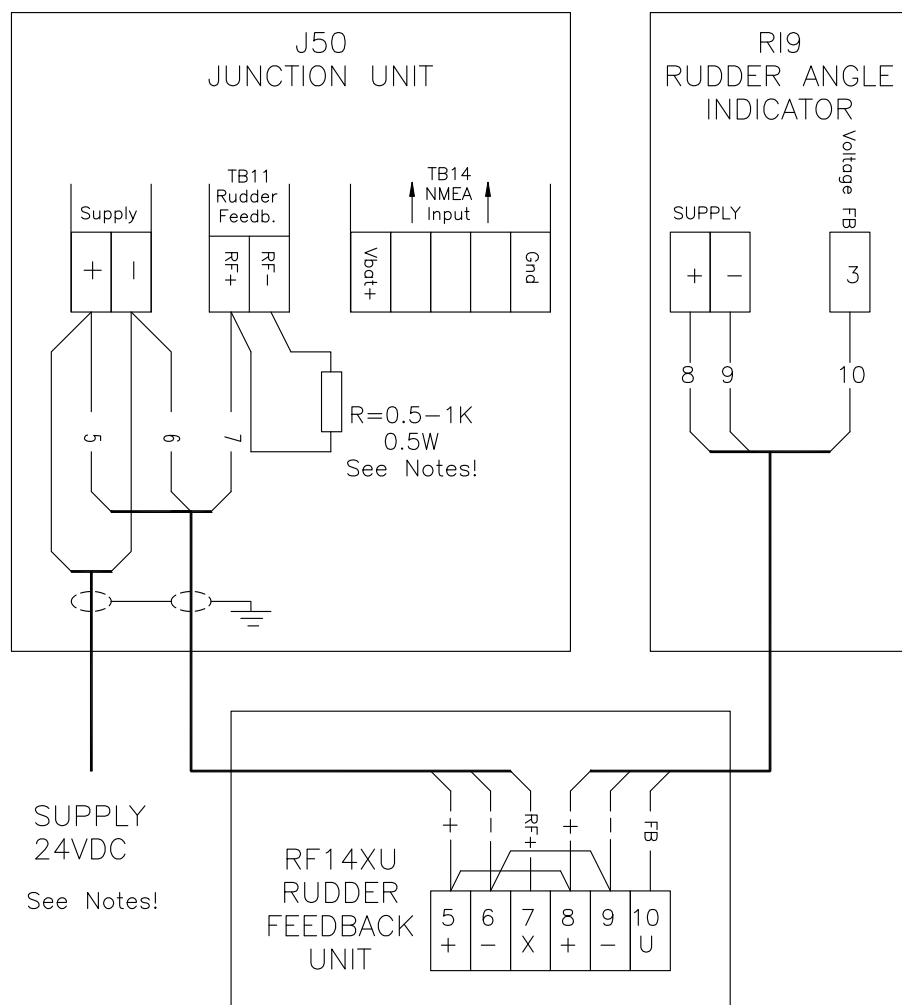


Fig. 1-5 RI9 in a AP50 system with RF14XU

The above connection diagram shows how to connect an RI9 Rudder Angle Indicator to an AP50 system with RF14XU Rudder Feedback Unit.

# Notes !

*This configuration is for 24VDC only.*

*The resistor R (0.5-1K, 0.5W) has to be mounted. The resistor is not supplied by Simrad.*

The RI9 Rudder Angle Indicator is connected to the U-terminal on RF14XU.

The connection shown above gives full functioning indicator(s) also with the autopilot switched off. To have the indicator(s) switched off with the autopilot, connect indicator(s) and rudder feedback supply+ to J50 Vbat+ instead of J50 Supply+.

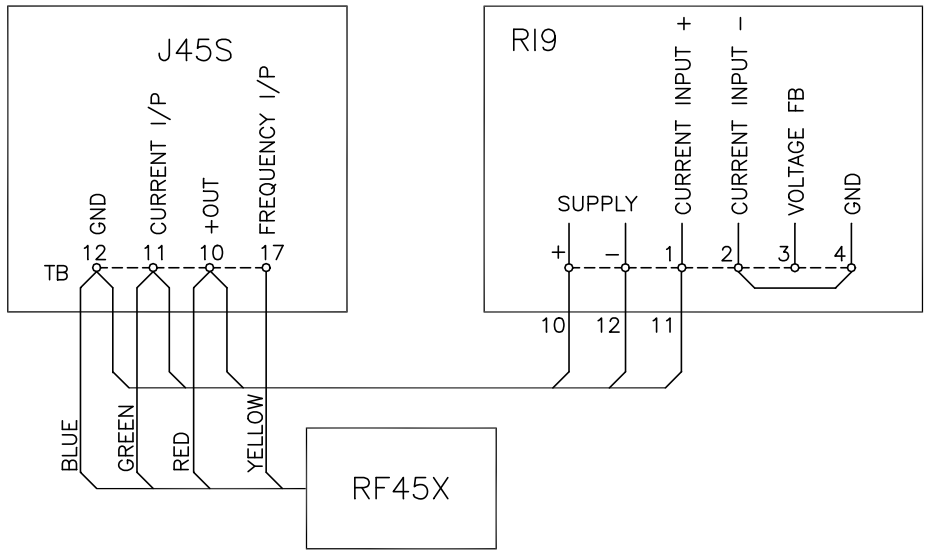


Fig. 1-6 RI9-J45S Wiring diagram

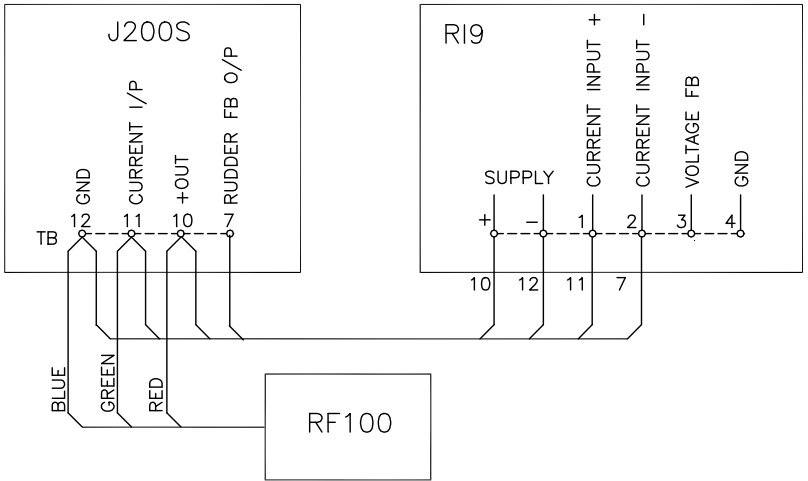


Fig. 1-7 RI9-J200S Wiring diagram

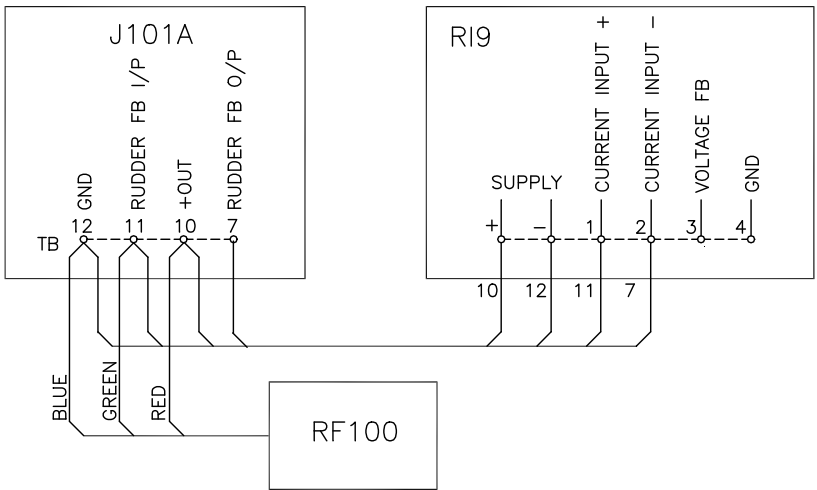


Fig. 1-8 RI9-J101A Wiring diagram

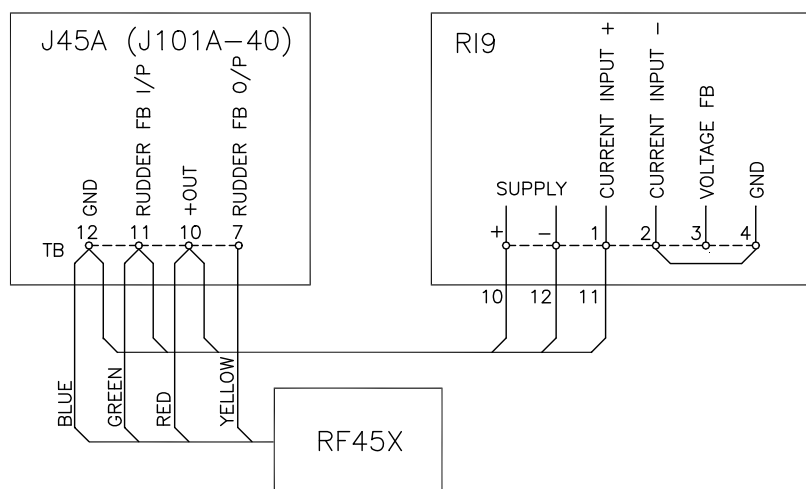


Fig. 1-9 RI9-J45A Wiring diagram

## RI9 set-up

The RI9 indicator is calibrated for voltage input signal (RF14XU Rudder Feedback Unit). Assuming that the mechanical linkage is in accordance with the instruction on Fig. 2-2 adjustment of the trimpotmeters marked Voltage FB, G (=Gain) and O (=Offset) is not necessary.

If the RI9 is indicating wrong/opposite direction, the meter deflection can be reversed by moving “jumper” ST1 from “Norm” to “Inv”.

### Note !

*The “Norm”/“Inv” jumper does not affect the meter deflection for current input signal. If the meter deflection has to be reversed, it must be made in the feedback unit as described for RF45 and RF14XI.*

If the current input signal is used (RF100, RF140, RF14XI, RF45), the reference inside RI9 has to be changed. This is done by opening the RI9 and move the “jumper” ST3 from “U” to “I” position (see Fig. 1-10).

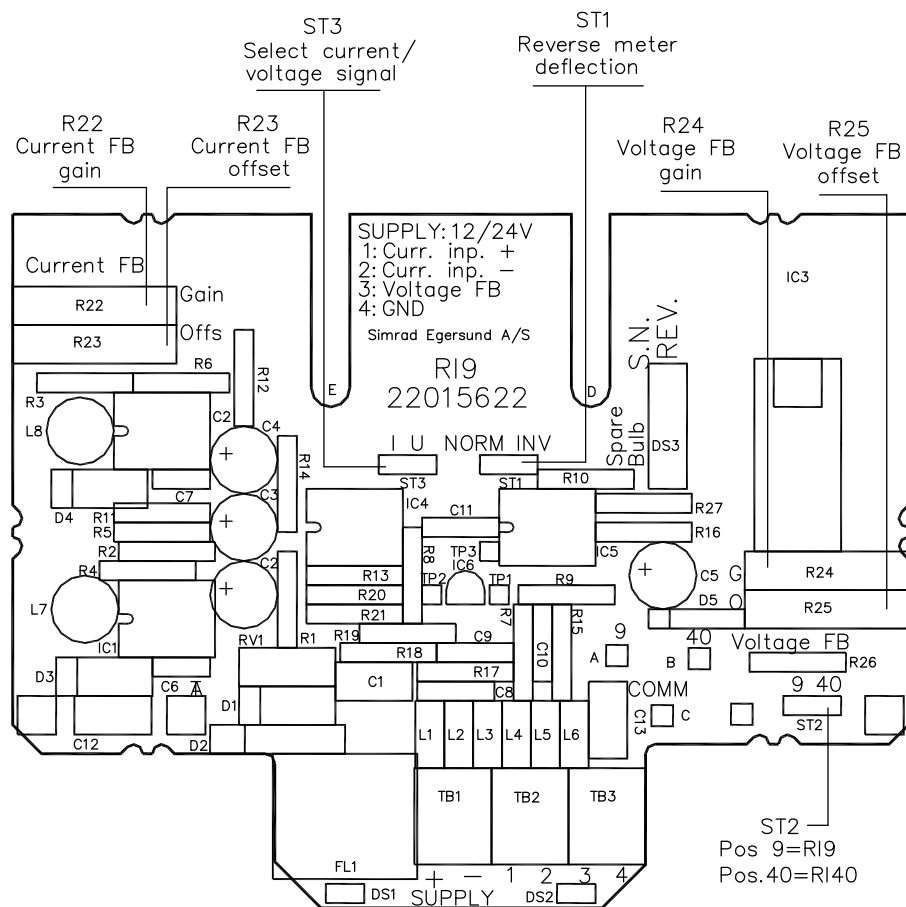


Fig. 1-10. RI9 Input signal selection

**Note !**

*When changing from voltage to current signal (or vice versa), the indicator may have to be recalibrated. In this case, or if the Gain and Offset trimpot's for other reasons are maladjusted, the following calibration procedure should be carried out:*

1. Take the rudder to midship position.
2. Use trimpot "O" (Offset) to calibrate RI9 to indicate zero rudder angle.
3. Move the rudder to e.g. 40 degrees (starboard or port). Use trimpot "G" (Gain) to calibrate RI9 to show the same angle as the rudder is set to (or the same angle as shown on the autopilot display in "Debug" mode).

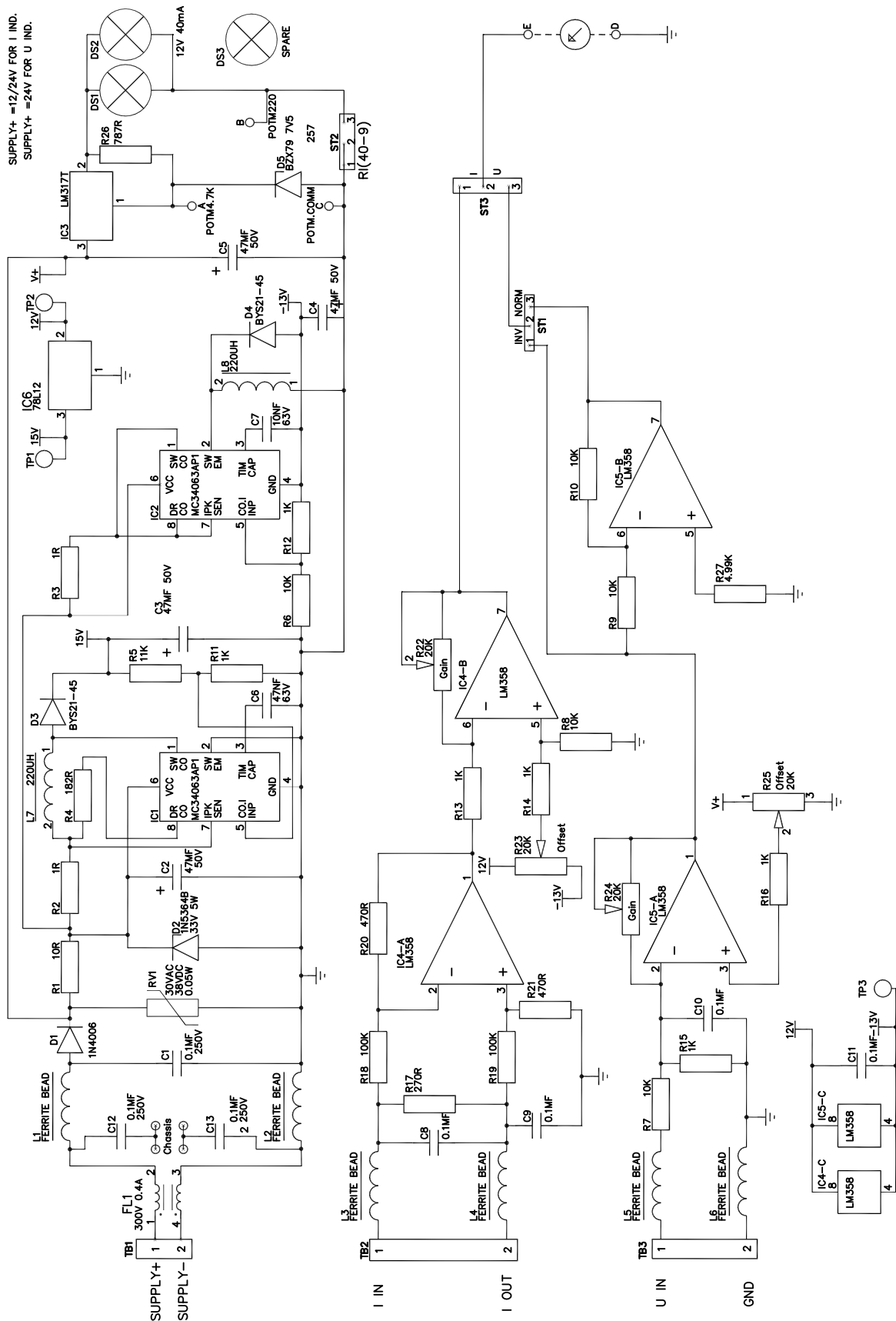


Fig. 1-11. RI9 Schematic diagram (N3-201562C)

## 1.4 Maintenance

Simrad rudder indicator equipment will need no special attention besides replacing illumination bulbs (See Fig. 1-12 for location of bulbs). It is, however, essential that the mechanical linkage between the rudder stock and the shaft of the rudder feedback unit is regularly checked and maintained in good condition to avoid misalignment.

## 1.5 Spare parts

Art.no.	Pos.	Description
22015655		RI9 Rudder Angle Indicator
22015663		Mounting kit
22015622	1	Printed Circuit Board Assy (PCB)
22015671	2	Instrument
22015028	3	Window
44117687	4	Light Bulb 12V 40mA
44155620	5	Potentiometer, 2.2K
44107423	6	Nut Cover
44149995	7	Dimmer Knob
44108496	8	Cap
22015606	9	Front panel plate
22015721	2	Instrument scale 60 degrees
22015697	2	Instrument scale 70 degrees
22015705	2	Instrument scale 90 degrees

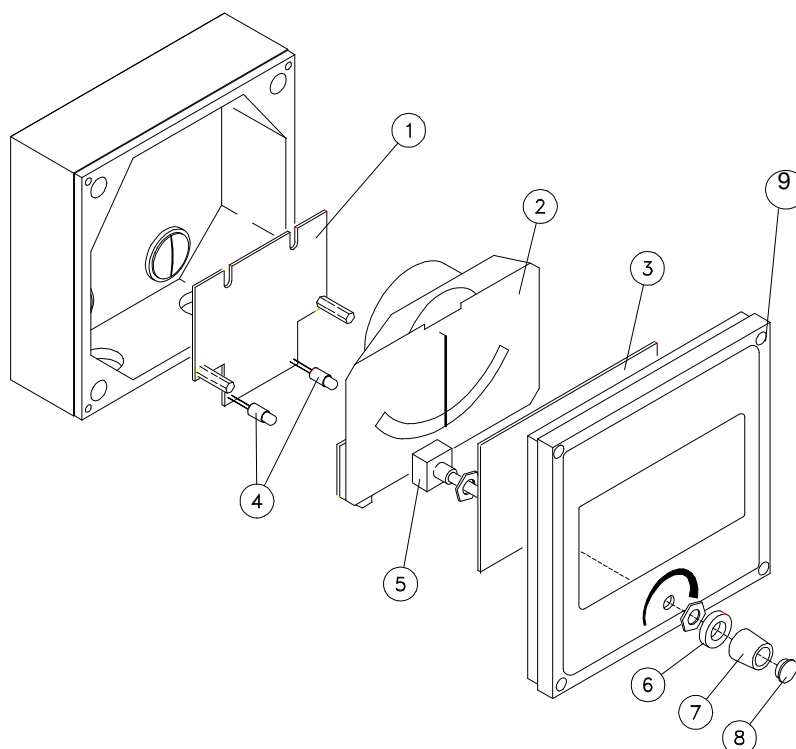


Fig. 1-12. RI9 Exploded view

## 2 RF14XU RUDDER FEEDBACK UNIT

### 2.1 General

The rudder feedback unit transmits a signal proportional to the rudder angle. It is mounted close to the rudder stock and is mechanically connected to the rudder by a transmission link in a 1:1 ratio.

The RF14XU Rudder Feedback Unit consists of a glass-reinforced non-flammable polyester housing with a mounting plate of sea-water resistant aluminium. It contains a potentiometer, limit switches and an electronic drive module. The electronic drive module contains a voltage section and a frequency section.

The voltage section outputs a voltage to the rudder angle indicator(s) which is proportional to the rudder angle. The voltage varies  $\pm 9$  volts around half the supply voltage.

The frequency section generates a variable frequency signal with 3400 Hz as midposition reference. This section is only used if a Simrad autopilot is connected to RF14XU. The signal varies at a rate of 20 Hz/degree, increasing when the rudder moves to port and vice versa.

The shaft of the Feedback Unit is free to travel 360 degrees, but only  $\pm 90$  degrees from midposition are used for signal control.

RF14XU is equipped with two sets of micro switches, which can be used as electrical limit switches for the steering gear.

## 2.2 Technical specifications

Dimensions:.....	See Fig. 2-1 and Fig. 3-2
Protection: .....	IP56
Ambient temperature:...	-10 - +55°C
Supply voltage:.....	24VDC -10%/20%
	Frequency section 12-40V DC
Output RAI:.....	Midship reference 0.5 x supply voltage
	Full deflection $\pm 9V$
Output autopilot:	3400Hz $\pm 20$ Hz/degree
No. of indicators:	5 in parallel
Rudder angle: .....	$\pm 45^\circ$ (changeable to 60, 70 or $90^\circ$ )
Limit switches: .....	Adjustable from $\pm 5^\circ$ to $\pm 160^\circ$

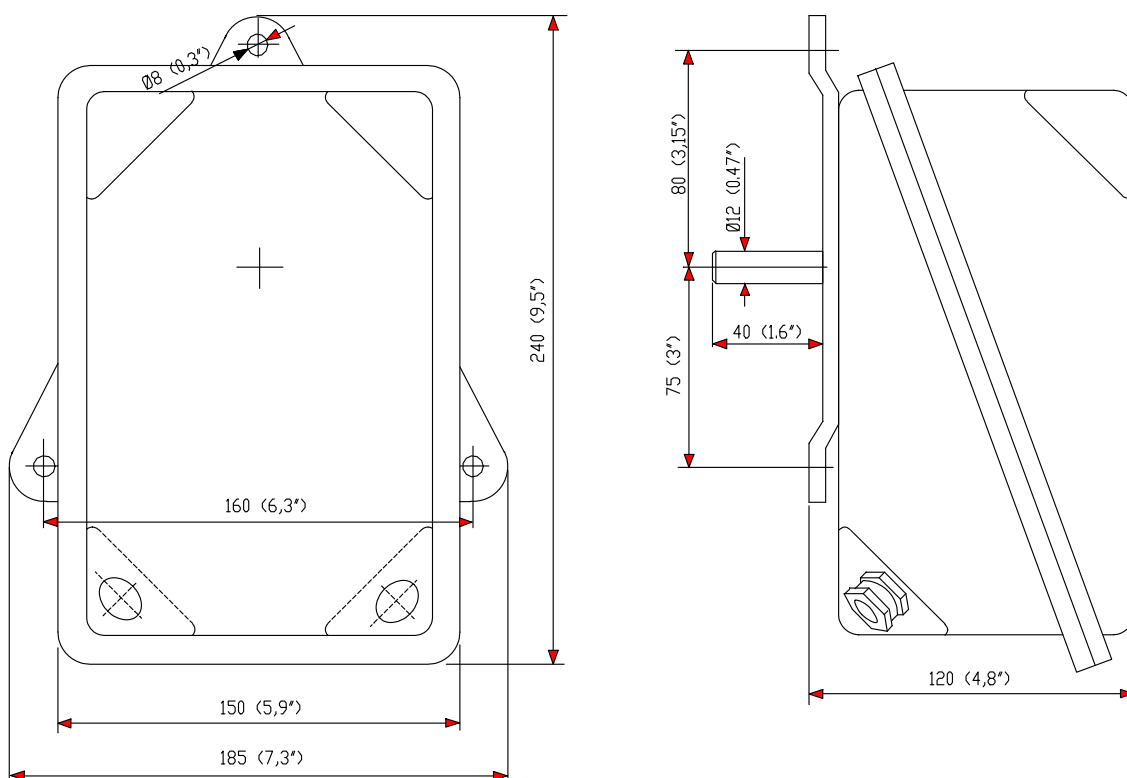


Fig. 2-1 RF14XU, dimensions



## 2.3 Installation

Before installation check that the alignment mark on the mounting plate agrees with the mark on the shaft. Bring the rudder to midships position. The feedback unit should be mounted on a plane surface and secured by bolts through the three holes in the mounting plate. It should be linked to the rudder in accordance with Fig. 2-2. It is important that the linkage is linear, i.e. the A-a and D-d are pairs of equal length. This will give a 1:1 ratio between the rudder travel and that of the feedback unit shaft.

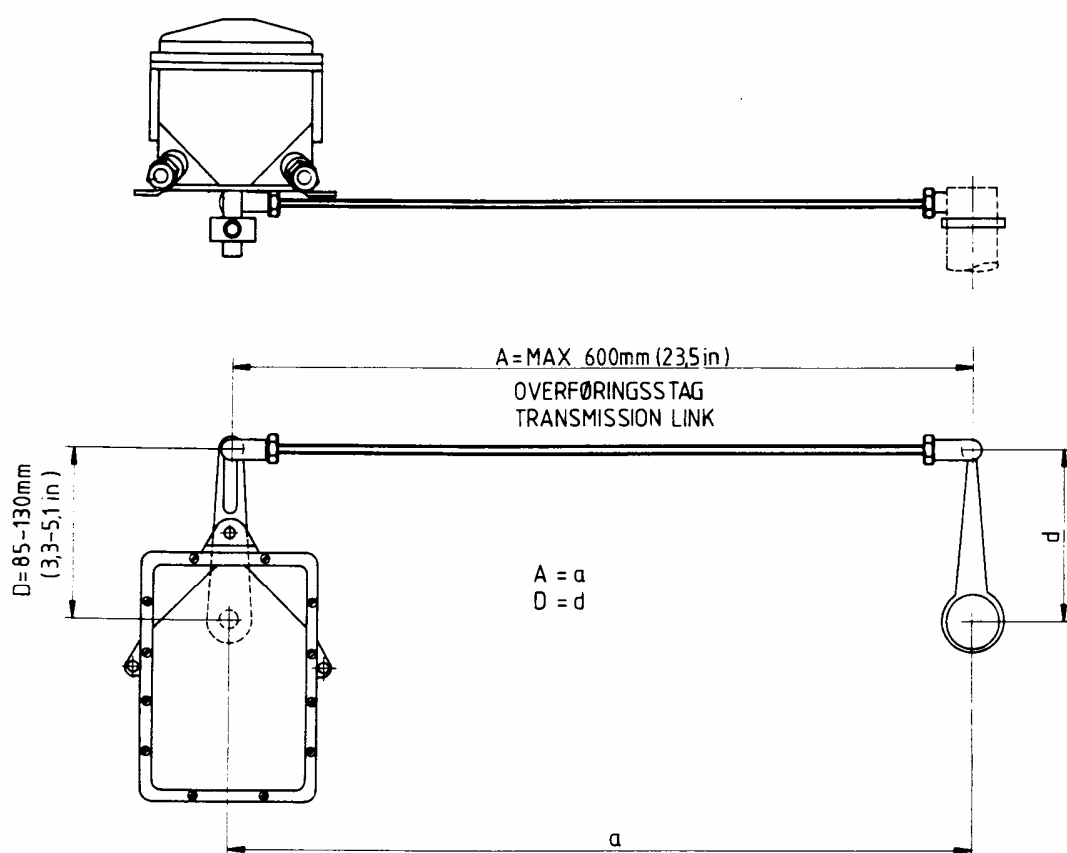


Fig. 2-2. RF14XU - Mounting

## 2.4 Wiring

Wiring to the RI9 is shown in Fig. 2-4 and Fig. 2-5. Fig. 2-6 - Fig. 2-8 show the combination of RI9 and Panorama connected to the RF14XU. Fig. 2-9 - Fig. 2-11 show the combination of RI9 and Panorama Mk2 connected to the RF14XU. The cables are carried through cable glands and connected to the terminal

board. To avoid any mechanical damage, the cables should be run in a conduit between the rudder feedback unit and the rudder indicator(s). The cable screen must be connected to the internal ground terminal. Ref. picture below.

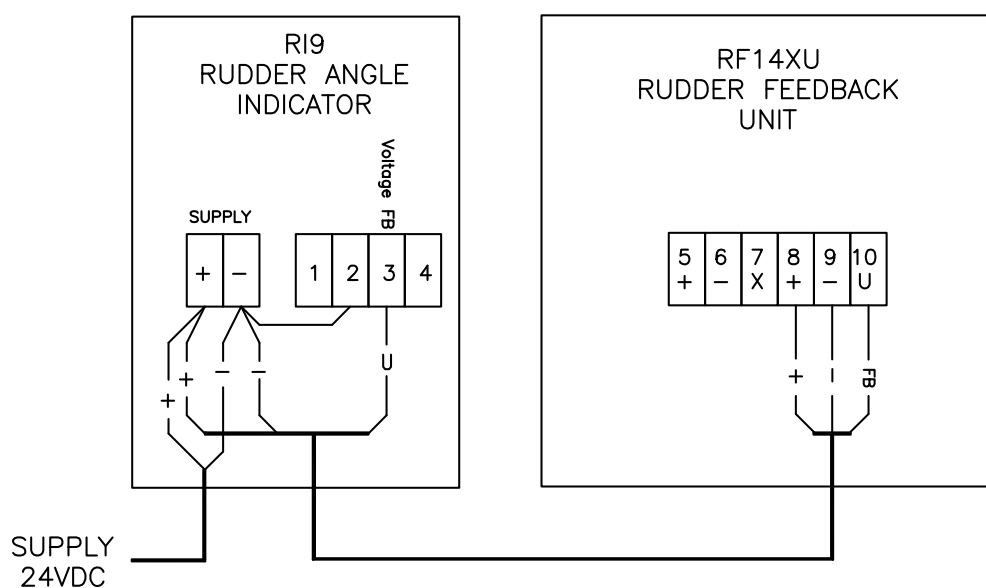


*Fig. 2-3 Screen termination*

The feedback unit has an external ground terminal and must have a proper ground connection to the hull. The grounding wire should be as short as possible and at least 10 mm wide.

**Note !**

*If the RF14XU and the indicators are powered from an unsmoothed 24V supply, the enclosed 470 $\mu$ F capacitor must be connected across the supply voltage terminals (+, -) to avoid off-set on the indicator reading.*



*Fig. 2-4. RI9-RF14XU Wiring diagram*

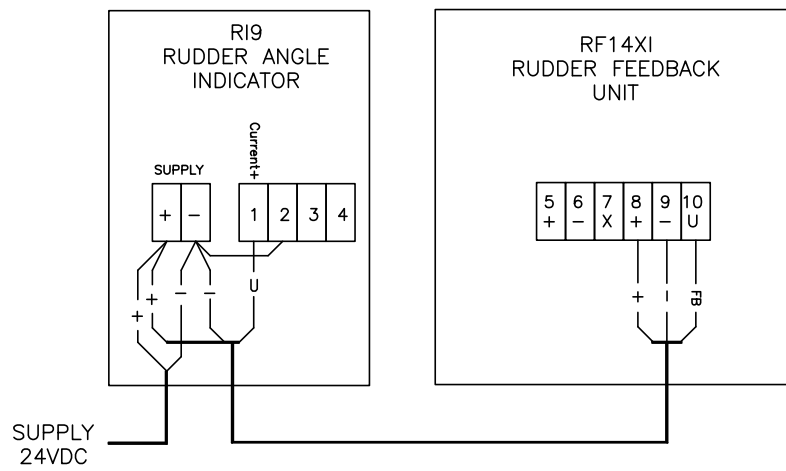


Fig. 2-5. RI9-RF14XI Wiring diagram

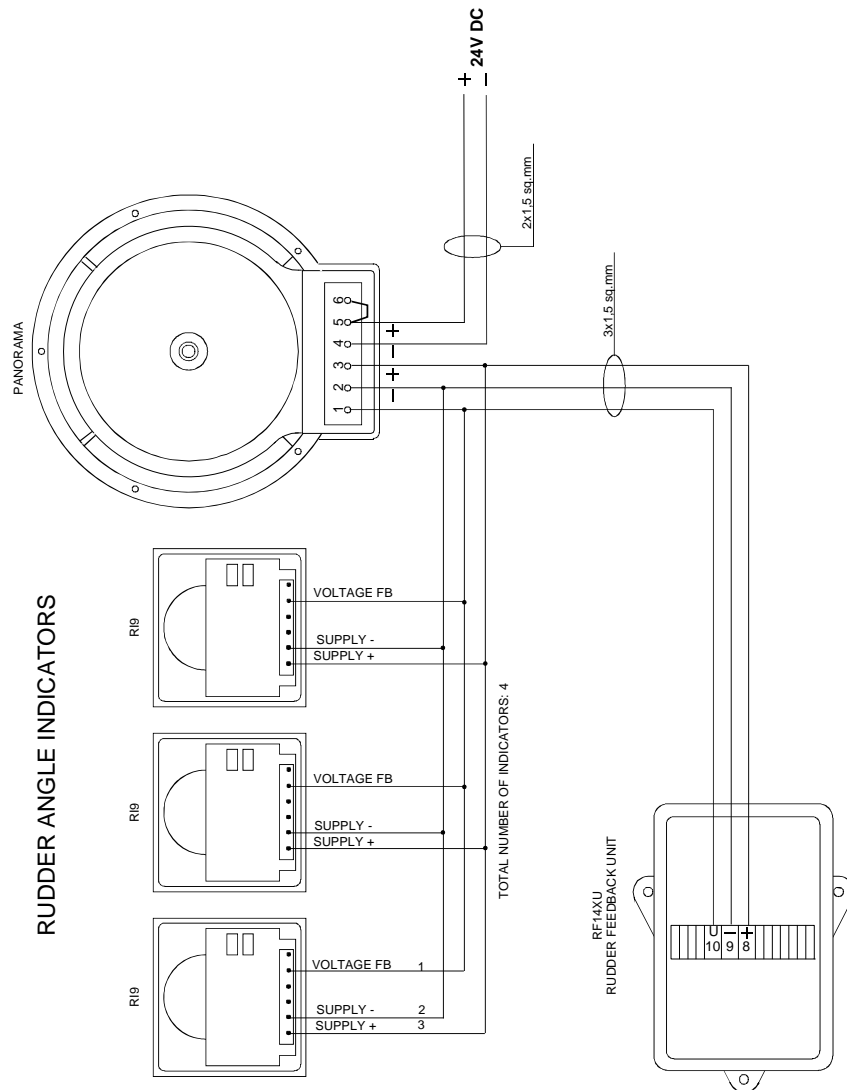
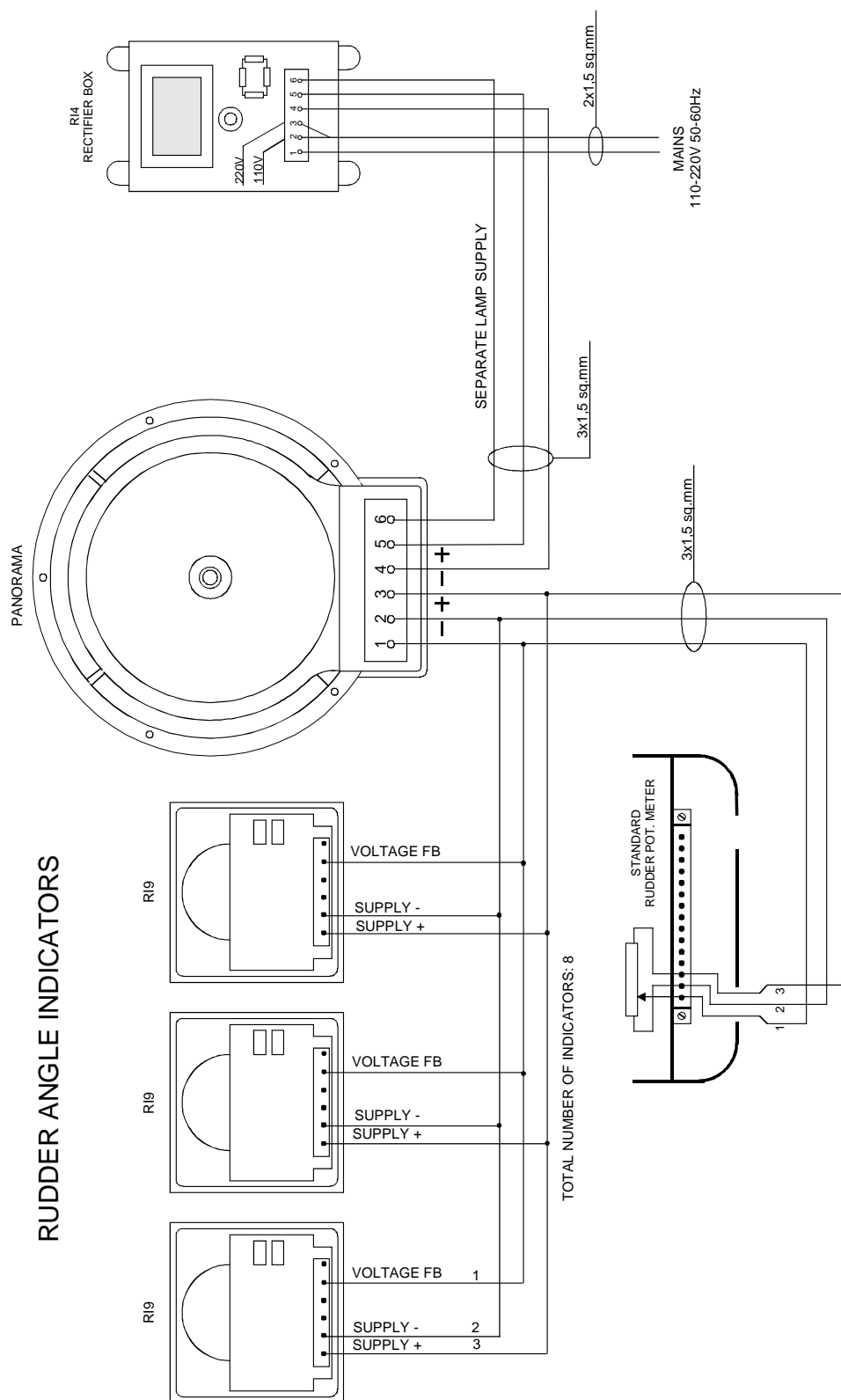
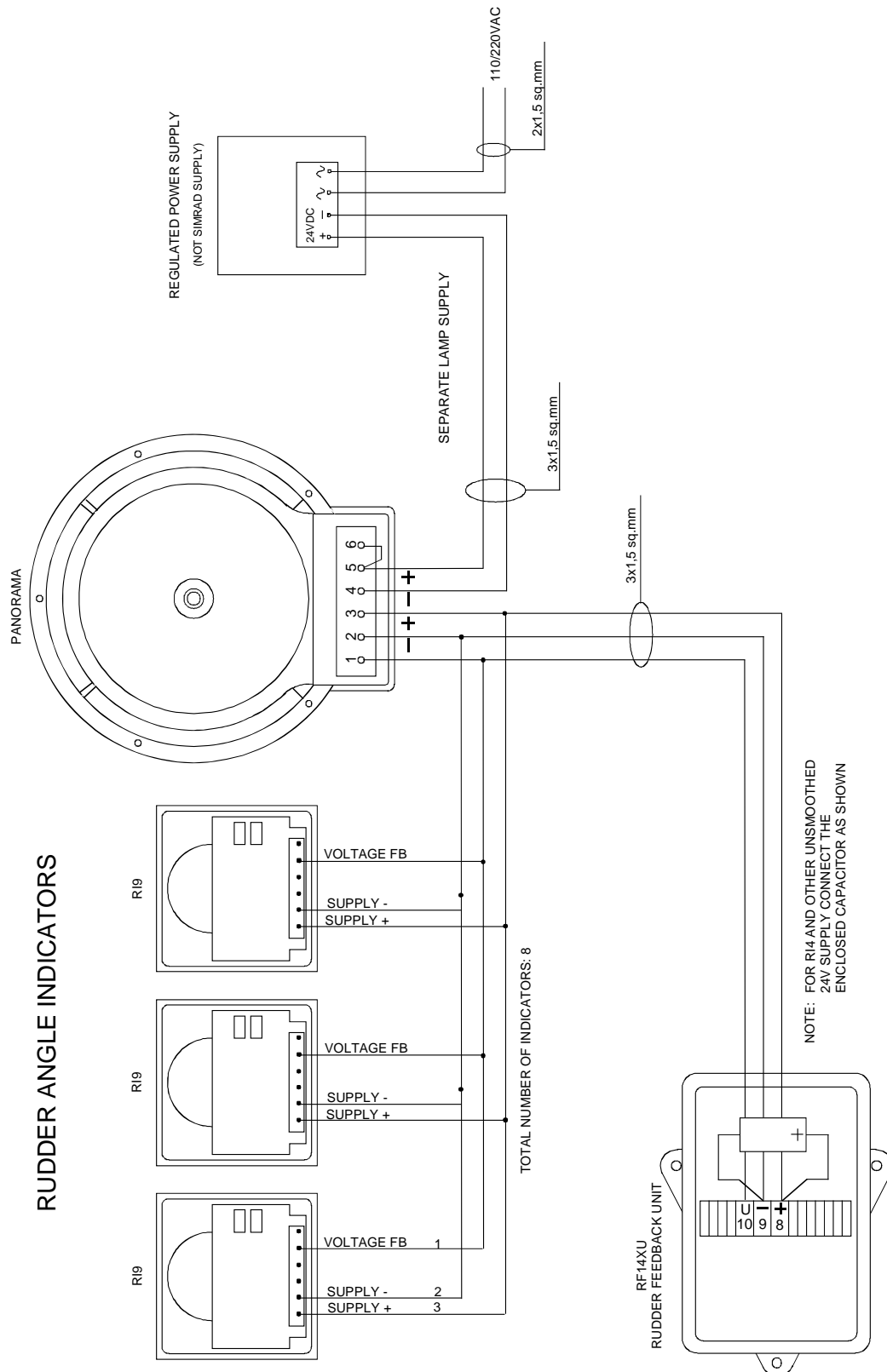


Fig. 2-6. Wiring diagram  
RI9, Panorama and RF14XU on 24V DC Mains

## Simrad RI9 Rudder Angle Indicator



*Fig. 2-7. Wiring diagram  
Panorama and RI9 on AC Mains using a Robertson RI4  
Rectifier and “standard rudder potentiometer”*



*Fig. 2-8 Wiring diagram  
Panorama and RI9 on AC Mains with regulated power supply*

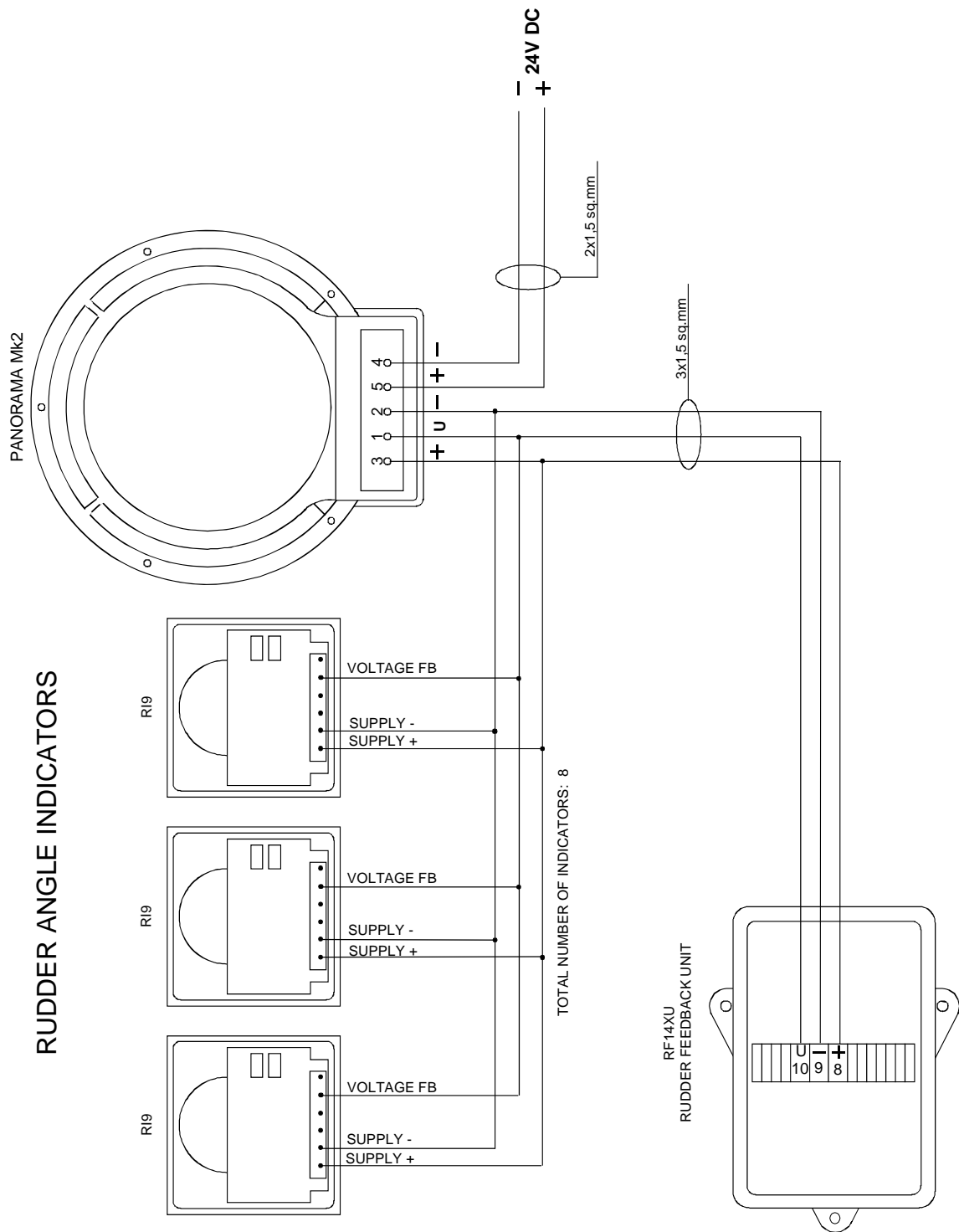
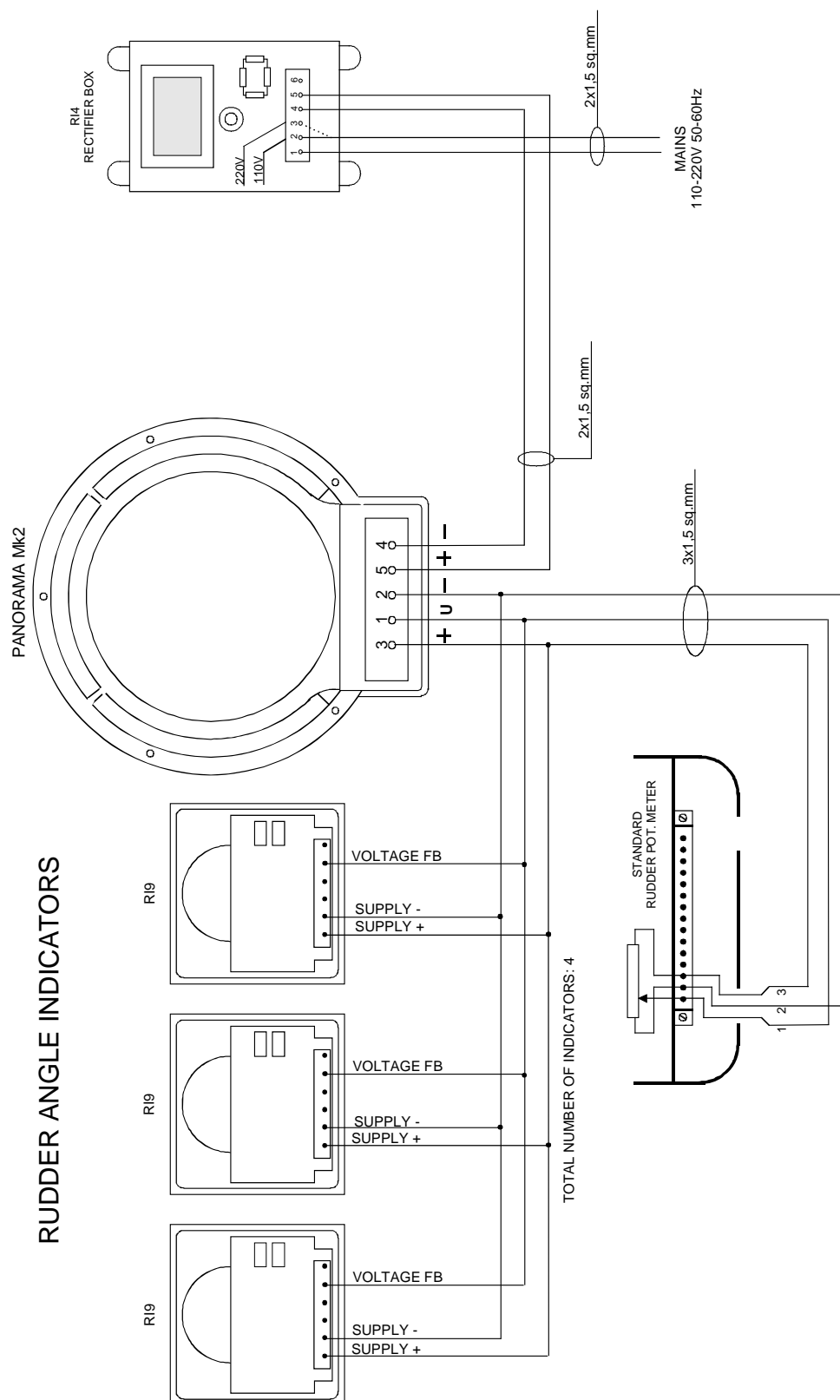
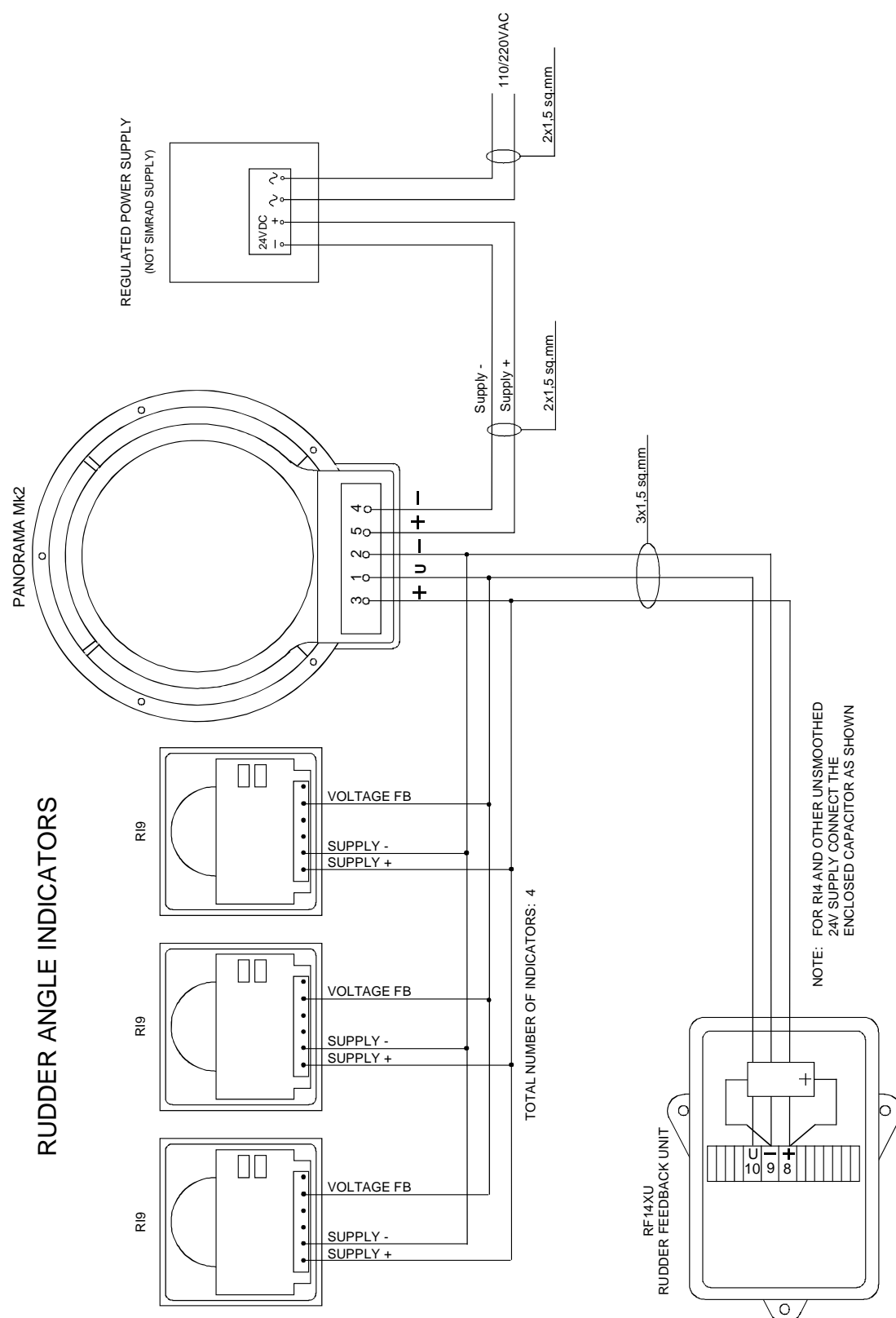


Fig. 2-9 Wiring diagram  
RI9, Panorama Mk2 and RF14XU on 24V DC Mains



*Fig. 2-10 Wiring diagram  
Panorama Mk2 and RI9 on AC Mains using a Robertson RI4  
Rectifier and "Standard Rudder Potentiometer"*



*Fig. 2-11 Wiring diagram  
Panorama Mk2 and RI9 on AC Mains with regulated power  
supply 110/220VAC – 24VDC 2A*



## 2.5 Other rudder angles

The RF14XU is normally delivered for  $\pm 45$  degrees rudder angle (violet, brown and pink leads are not connected). For  $\pm 60$  degrees, connect brown lead to terminal 10. For  $\pm 70$  degrees, connect pink to terminal 10 and for  $\pm 90$  degrees, connect the violet lead to terminal 10. White lead must remain connected. To reverse the indicator deflection, the brown lead to terminal 8 must be connected to terminal 9. All is referred to connections between the terminal board and the internal of RF14XU, see Fig. 2-12

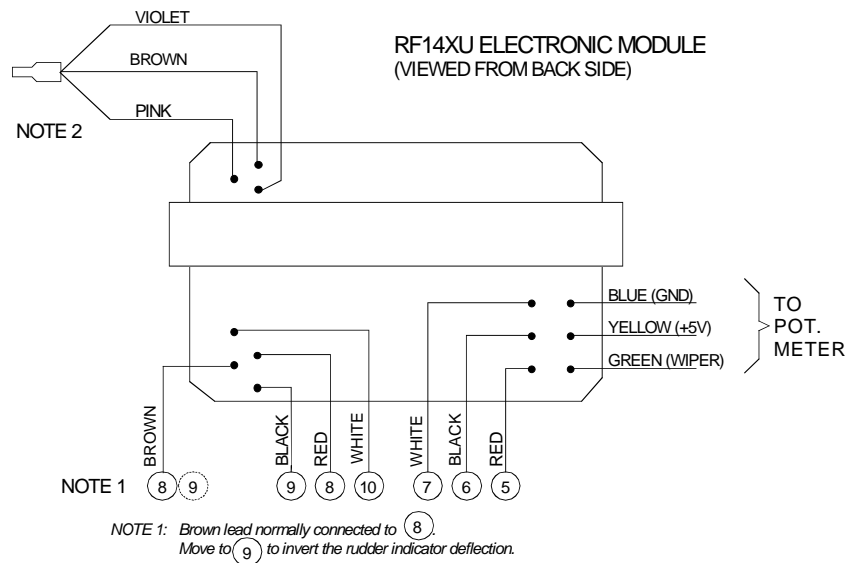
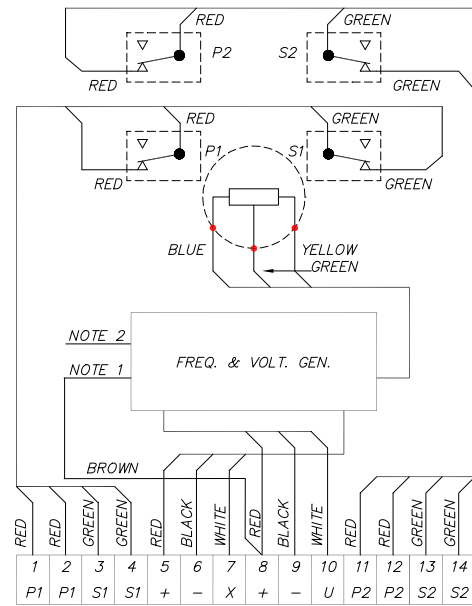


Fig. 2-12. RF14XU, Internal wiring

Note !

Inside the Feedback Unit cover, a piece of moisture protecting sponge is attached. The sponge produces a corrosion preventive gas, and to increase the long-range efficiency of the gas, avoid keeping the unit open over long time periods.

## 2.6 Adjustments

After having tightened all mechanical parts and connected all cables, the following adjustment must be carried out:

1. Check that the rudder is set to midship position.
2. Measure the voltage between "U" and "+", respectively "-" on the RF14XU terminal board. If the two measured voltages do not have the same numerical value, loosen the two clamping screws on the potentiometer and turn the potentiometer housing. (Fig. 2-13 pos. 5) until the same numerical value is measured. The RF14XU is now set to midposition. Tighten the two clamping screws.

After installation, the cable glands should be sealed with silicon to prevent water from seeping in. Also apply silicon grease to the gasket between the bottom and top cover.

## 2.7 Spare parts

<u>Part no.</u>	<u>Pos.</u>	<u>Description</u>
22504005		Transmission Link
44132306		Ball joint
22500300		Shaft coupling
22500458	1	Gasket
22501605	2	Electronic XU drive module
44105120	3	Actuator
44105146	4	Limit switch
44118388	5	Potentiometer 5Kohm
44132033	6	Corrosion inhibitor sponge
22500284	7	Activator block
22500276	8	Activator disc

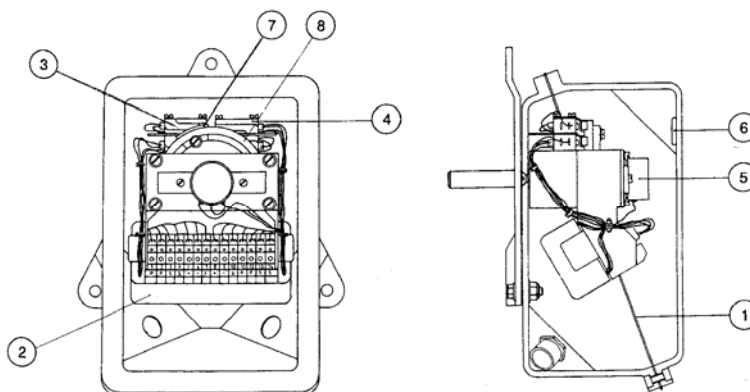


Fig. 2-13 RF14XU - Spare Parts

## 3 RF45X RUDDER FEEDBACK UNIT

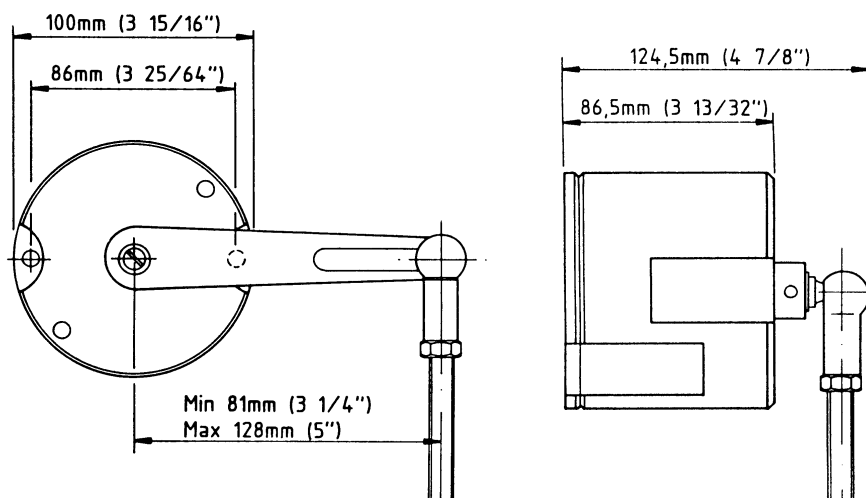
### 3.1 General

The RF45X is a medium duty rudder feedback unit. Mechanically it is identical to its predecessor RF45, therefore it is a repairable rather than a potted throw away item. Electrically it outputs a frequency (pulse width modulated) signal that matches with the J3XX input (AP35/AP50), but it can also output a frequency signal (selectable via internal jumpers) that matches with AP45 and AP9 Mk3. The RF45X can also operate on 24V DC, a useful feature when connected in a stand alone rudder angle indicator system.

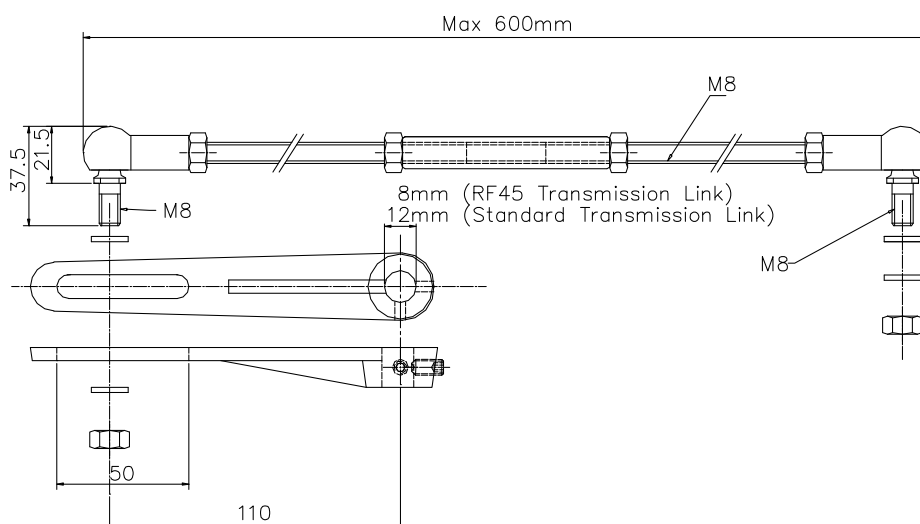
The unit is mounted close to the rudder stock and is mechanically connected to the rudder by the RF45 transmission link.

### 3.2 Technical specifications

Dimensions:	See Fig. 3-1 and Fig. 3-2.
Weight:	1,0 kg (2,2 lbs.)
Material:	Polyacetal (POM)
Supply voltage:	12-24 VDC -10%/+30%, system supplied
Environmental Protection:	IP56
Temperature range:	
Operation:	-25 to +55°C (-13 to +130°F)
Storage:	-30 to +80°C (-22 to + 176°F)
Cable:	2 m (6 ft.)
Rudder angle:	± 45°
Output signal:	Polarity-independent frequency signal
Frequency resolution:	Center: 3400 Hz, 20 Hz/degree of change
Linearity:	± 3° up to 45° of rudder
Current output for rudder angle indicator (only for stand-alone system)	0.1mA - 1.1mA
Number of indicators (only for stand-alone system):	5 in series



*Fig. 3-1 RF45X – Dimensions*



*Fig. 3-2 RF45/Standard Transmission Link - dimensions*

### 3.3 Mounting

The RF45X is normally mounted with the shaft pointing upwards. It can, however, also be mounted with the shaft pointing downwards if that appears to be more convenient. The deflection can then be inverted as illustrated in Fig. 3-4.

An “upside-down” installation will make access to within the unit more convenient as the unit can be opened without moving it from the mounting base. To open the unit, unscrew the two screws at the bottom and remove the cover. Be careful with the wires when you put back the cover.

Use the attached template to drill the required mounting holes. The unit is fastened to the mounting base by the two Allen screws enclosed. (Other types of screws may be used if fastened to i.e. a wooden base.)

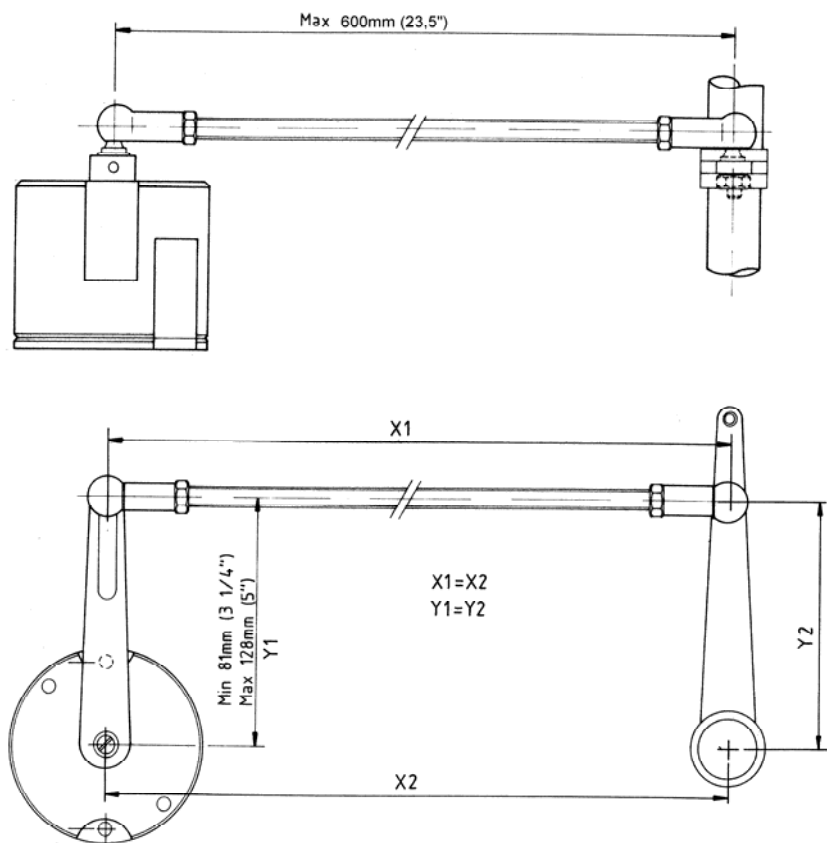


Fig. 3-3 RF45X - Mounting

Make the parallelogram configuration of the transmission link (see Fig. 3-3) with the rudder amidships and temporarily fasten the link to the RF45X shaft. The transmission rod can be shortened by cutting off a piece using a hacksaw. Move the rudder manually h.o. - h.o. and make sure the transmission link is moving freely in both directions.

3.4 Electrical connection

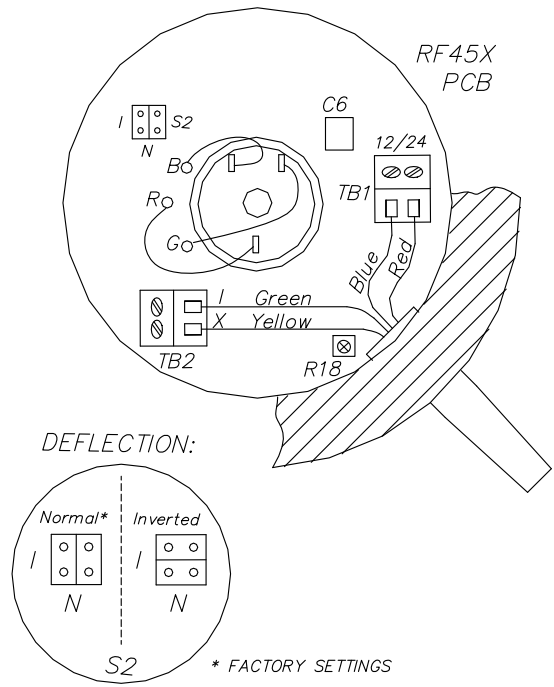


Fig. 3-4 RF45X Internal Wiring

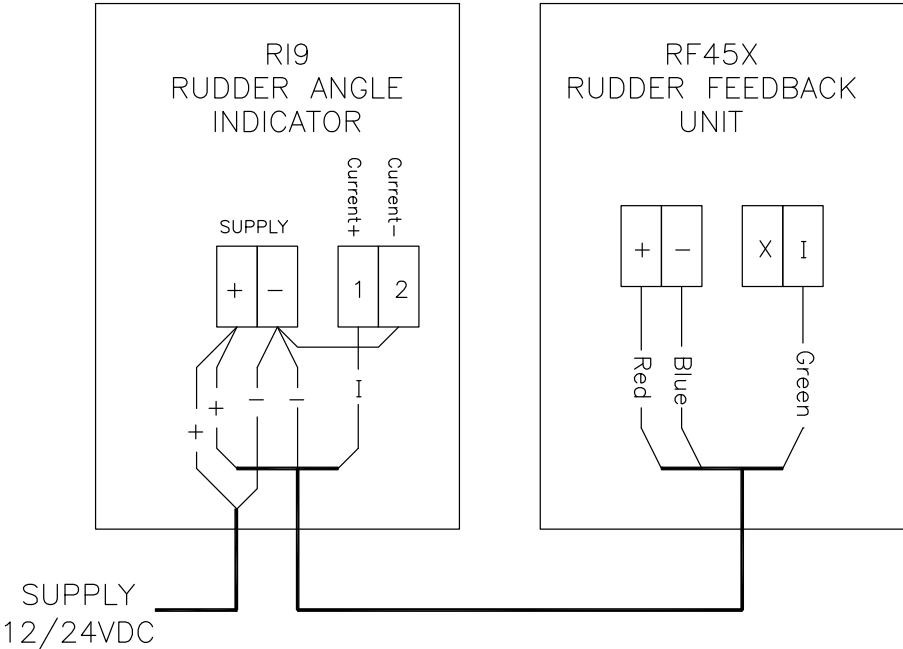


Fig. 3-5. RI9-RF45X Wiring diagram

Note ! For RF45X the supply voltage can be 12/24VDC.

### 3.5 Spare parts

22011290	RF45X Rudder Feedback Unit
22011217	Mounting kit
22011365	Potentiometer 10K (with wires)
44156321	O-ring 64,5x3 mm
22011258	RF45X PCB ass'y with potentiometer (10K)
44156925	Junction box
22011183	RF45 Transmission Link, Complete
44132322	Transmission Rod M8x300mm (2)
22504054	Joint Nut M8
44157097	Ball Joint Socket
22504039	Transmission Lever
22011209	Ball Joint Pin

